

## Simple Solutions for Space Station Audio Problems

Throughout this summer, a number of different projects were supported relating to various NASA programs, including the International Space Station (ISS) and Orion. The primary project that was worked on was designing and testing an acoustic diverter which could be used on the ISS to increase sound pressure levels in Node 1, a module that does not have any Audio Terminal Units (ATUs) inside it. This acoustic diverter is not intended to be a permanent solution to providing audio to Node 1; it is simply intended to improve conditions while more permanent solutions are under development. One of the most exciting aspects of this project is that the acoustic diverter is designed to be 3D printed on the ISS, using the 3D printer that was set up earlier this year. Because of this, no new hardware needs to be sent up to the station, and no extensive hardware testing needs to be performed on the ground before sending it to the station. Instead, the 3D part file can simply be uploaded to the station's 3D printer, where the diverter will be made.

As part of this project, four prototype models have been 3D printed on the ground over the past few months, using the 3D printer in Building 44 at JSC. These models were all tested in the Building 44 anechoic chamber using a test setup (shown in Figure 1) that was designed to mimic the ATU setup on the ISS. In this testing, sound pressure measurements were taken in many different locations to determine the effect that the diverter would have on the sound emitted from the speaker. This data was used to attempt and optimize the design of the diverter. Once the design was optimized, testing of the diverter was performed in the ISS mockups in Building 9 at the Space Vehicle Mockup Facility, as seen in Figure 2. This testing gave us a very accurate idea of how the diverter would affect sound pressure values in and around Node 1 if the diverter were installed. Now that that testing is complete, the design is ready to be sent to the In Space Manufacturing team at Marshall to prepare it for printing.

Over the summer, a number of other projects were supported as well, both within EV3 and for other organizations. One of these projects included designing and manufacturing a prototype of a radiation beam degrader for EV5, the Electronic Design and Manufacturing Branch. The beam degrader is a device which needs to be able to place a variable amount of polyethylene into a radiation beam to facilitate testing at different radiation intensities. This device needs to be fully controllable from outside of the radiation test chamber to simplify the

testing process. At the beginning of the summer, EV5 provided the specifications that they would want in a final product, and a design was conceptualized to meet those specifications. A small scale prototype of this design, shown in Figure 3, was then created using the Building 44 prototype shop. As a whole, this project provided a great opportunity to go through the entire engineering process of creating a new product. Many obstacles needed to be overcome throughout the process, and a final prototype was produced in the end.

Overall, many fascinating projects were completed over the course of this summer internship. For the acoustic diverter project, hardware should be 3D printed onboard the ISS in the very near future. While the other projects discussed here are not going to directly lead to flight hardware, they will provide great value to engineers on the ground designing future electronics for missions to Mars and beyond.



Figure 1: Test Setup for the Acoustic Diverter constructed in the Building 44 Anechoic Chamber



Figure 2: Acoustic Testing Setup inside the US Lab Mockup in Building 9



Figure 3: Beam Degradation Prototype Design